UNITED STATES PATENT APPLICATION FOR:

TITLE:

SELF ENERGIZING CONNECTOR

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SPECIFICATION

FIELD

[0001] The present embodiments relate to a coupling device for high pressure tubing using a coupling nut to effect a pressure-tight connection to other system components.

BACKGROUND

[0002] The present application claims priority to co-pending U.S. Provisional Patent Application Serial No. 60/461,072 filed on April 08, 2003, entitled "Self Energizing Connector".

[0003] Known connectors for high pressure applications have problems, wherein the tubes pop out of their engagements at high pressure. After considerable testing, it was determined if the tube could be constrained, then the tubes could be pressured to very high pressures without leaking.

[0004] One such tube connector is described in US Patent No. 5,192,095. In the patent, a tube connector is described that provides a coupling device for high pressure threaded pipe connection to a coupling body with a standard 24-degree connector, a coupling nut to establish a pressure tight connection and a shaped pipe or a connection stub for connection to other system components. An adapter ring is proposed with a cylindrical internal bore and radially progressing and/or domed end ring faces of different sizes, at least one of which is formed as a sealing face fitted with a ring seal, to each of which an axially directed cylinder outer face is juxtaposed, between which a 24-degree outer bevel is arranged to adapt to the coupling body. The ring face of the adapter ring which when fitted is directed

towards the connection stub or the flared flange of the shaped pipe is provided with an annular groove to accept a ring seal or an o-ring. However, this connector still pops out of its engagement position at high pressures.

[0005] The present invention was designed to overcome these problems with improved sealing at high pressures.

SUMMARY

[0006] The self energizing tube connector for engaging a pressurizable part and associated is for use with pressurizable parts, such as a subsea Christmas tree or a BOP. The tube is capable of sustaining pressures up to 50,000 psi without deforming having an upstream tube end and a downstream tube end. Over this tube is placed a ferrule assembly having three basic parts, a front ferrule, a rear ferrule and a lifting component, which in the preferred embodiment is of a tapered construction. The lifting component slidingly engages the front ferrule thereby forming both an upstream seal between a pressurizable part, such as a blow out protector (BOP) and the tube and a downstream seal between the front ferrule and the tube. A coupling nut slides over the tube and is located downstream of the rear ferrule for engaging the pressurizable part. The coupling nut is adapted to tighten against the rear ferrule, front ferrule and lifting mechanism to compress the rear ferrule, front ferrule and lifting mechanism against the pressurizable part and the tube.

[0007] The method for using the tube connector with a pressurizable part entails sliding a coupling nut, such as a jam nut, over a tube. Next, a rear ferrule is slid over the tube. A front ferrule is slid over the tube after the rear ferrule, and then a lifting component is slid over the tube forming a ferrule assembly. Next, the tube with ferrule assembly is inserted into the pressurizable part. Pressure is then applied using the coupling nut

onto the ferrule assembly and the ferrule assembly then forms both an upstream seal and a downstream seal between the tube and the pressurizable part.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The present embodiments will be explained in greater detail with reference to the appended Figures.

[0009] FIG 1 depicts a cross sectional view of the tube in the pressurized part.

[00010] FIG 2 depicts a detailed cross section of the connector.

[00011] FIG 3 depicts a detail of the lifting component usable in the tube connector.

[00012] FIG 4 depicts a top view of an alternative embodiment of the lifting device of FIG 3.

[00013] FIG 5 depicts an end view of the lifting device of FIG 3.

[00014] FIG 6 depicts a detail of the front ferrule usable in the tube connector.

[00015] The present embodiments are detailed below with reference to the listed Figures.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[00016] Before explaining the present embodiments in detail, it is to be understood that the embodiments are not limited to the particular embodiments herein and it can be practiced or carried out in various ways.

[00017] The present embodiments are directed to a tube connector and a method for using the tube connector.

[00018] FIG 1 shows a cross sectional view of the tube in a pressurized part according to the invention.

[00019] The tube connector engages a pressurizable part 8. The tube connector is made from a tube 10 capable of sustaining pressures from about 1 atm to about 50,000 psi without deforming. Tube 10 has an upstream tube end 12 and a downstream tube end 14. A ferrule assembly 20 is shown slidingly engaging the tube 10. FIG 1 also shows the ferrule assembly 20 having the three basic components, the front ferrule 22, the rear ferrule 24 and the lifting component 26. A coupling nut 32 is shown in a slidingly engagement around tube 10. The coupling nut 32 is preferably a jam nut, but could also be a compression nut or similar compression device for exerting pressure on the tube 10.

[00020] FIG 2 shows a detail of the ferrule assembly which consists of a front ferrule 22; a rear ferrule 24 and a lifting component 26. In a preferred embodiment, each ferrule is of a ring construction for fitting around the tube. The front ferrule 22 slidingly engages the rear ferrule 24. The lifting component slidingly engages the tube 10 and the front ferrule 22.

[00021] The lifting component 26 preferably has a wedge shape.

[00022] The lifting component, when it slidingly engages with pressure from the coupling nut 32 the front ferrule 22 forms an upstream seal 28 between pressurizable part 8 and tube 10. Simultaneously with this force from the coupling nut or jam nut 32, a downstream seal 30 is formed.

[00023] The coupling nut 32 slides over the tube 10 and is disposed downstream of the rear

ferrule 24 for engaging the pressurizable part 8. The coupling nut can be tightened against the ferrule assembly 20 which consists of the rear ferrule, front ferrule and lifting mechanism. The coupling nut applies force to the rear ferrule, front ferrule and lifting mechanism against pressurizable part 8 and the tube 10, typically deforming the rear ferrule, front ferrule and lifting mechanism in order to create the two simultaneous seals.

[00024] In a preferred embodiment, the tube can have an outer diameter of between about 1/16 inch and up to 12 inches. In a more preferred embodiment, the tube has an outer diameter of between about 1/8 inch and about 1 inch.

[00025] It is contemplated to be within the scope of the invention that the front ferrule, rear ferrule and lifting components are made from a deformable material such as metal or plastic and can deform upon compression due to the coupling nut.

[00026] It is contemplated that the tube 10 could be a metal tube or a plastic tube. The preferred metal is contemplated to be stainless steel. Alternatively, a duplex material such as a Duplex 2205 or Duplex 2207 corrosion resistant material available from Gibson of Bridgewater, New Jersey could be used.

[00027] The tube connector of the present invention is contemplated to sustain without failure, pressures which range between about1 atm and up to about 50,000 psi, more preferably between 1 atm and 25, 000 psi.

[00028] As to the coupling nut for use in the invention, in the most preferred embodiment, this nut is a jam nut with threads for engaging threads of a pressurizable part.

[00029] This invention is contemplated for use with pressurizable parts such as: down hole safety valves, chemical injection assemblies, tubing hangers, blow out preventors,

subsea Christmas trees, or packers.

[00030] FIG 3 is a detail of the lifting component 26 in the tube connector of the invention. In a preferred embodiment, the lifting component has a ring shape. The ring has an upstream edge 34 and a downstream edge 36 and wherein the upstream edge is larger in diameter than the downstream edge 36.

[00031] FIG 4 is a top view of the lifting component 26 wherein the lifting component can additionally comprise a groove 38 disposed adjacent the upstream edge 34 to prevent sealing at the upstream edge of the lifting component 26.

[00032] FIG 5 is an end view of the lifting component of FIG 3.

[00033] FIG 6 is a detail of the front ferrule 22 usable in the tube connector of the invention. In the preferred embodiment, the front ferrule has a conical shape for engaging the pressurizable part. The front ferrule 22 has a front portion 40 for engaging the lifting component 26 and a back portion 42 for engaging the rear ferrule 24. In a preferred embodiment this front ferrule is a solid material having a diameter which is slightly less than the inner diameter of the tube.

[00034] The rear ferrule 24 is a ring shape and preferably tapered on each end. In the most preferred embodiment the rear ferrule acts like a wedge. Preferably this rear ferrule is constructed from solid steel.

[00035] The invention also relates to a method for using a tubular connector with a pressurizable part, such as a BOP or subsea Christmas tress. The method begins by sliding a coupling nut over a tube, sliding a rear ferrule over the tube, sliding a front ferrule over the tube, and sliding a lifting component over the tube. Sliding a lifting component over the tube forms a ferrule assembly over the tube.

[00036] The method ends by inserting the tube into a pressurizable part and applying pressure using a coupling nut to the ferrule assembly forming both an upstream seal and a downstream seal between the tube and the pressurizable part.

[00037] The method also contemplates that the step of sliding a coupling nut over the tube uses a jam nut over the tube.

[00038] While this invention has been described with emphasis on the preferred embodiments, it should be understood that within the scope of the appended claims the invention might be practiced or carried out in other than as specifically described herein.

[00039] For example, the ferrules could be made of laminates or composites as well as metal. A variety of coatings could be used to reduce electrical conductivity with formulations optimized for the specific application

[00040] The embodiments have been described in detail with particular reference to certain preferred embodiments thereof, but it will be understood that variations and modifications can be effected within the scope of the embodiments, especially to those skilled in the art.